

Definition

Human nutrition is the science of diet and its interactions with growth, development, physiology, metabolism, and composition of the human body. It involves the role of nutrition in normal and abnormal individuals, the impact of nutrition on health and disease, and the interactions between diet, host, and environment.

Technique

Clinicians need to have a basic understanding and awareness of nutrition in order to optimally promote health maintenance, prevent disease, facilitate recovery from illness, and augment the treatment of medical and surgical disease states. Awareness and application of nutrition in medical practice has a major impact on health care in our society.

A detailed nutritional history is not necessary for most patient evaluations. Nevertheless, it is important for the clinician to be cognizant of clues in the routine history, physical examination, and laboratory data that should prompt inquiry into specific nutritional habits or further assessment by selective examination and laboratory studies.

The intent of this section is not to review methods of clinical assessment leading to various diagnoses such as Crohn's disease, hypertension, alcoholism, nontropical sprue, or pernicious anemia. These diagnoses should become evident through appropriate evaluation. At the point these and other nutrition-related diagnoses are entertained however, consideration of nutritional disorders and a selective nutritional history can be very important. In addition, as our society has adopted varied nutritional habits, certain questions should be part of the routine evaluation. These are delineated in Table 81.1.

Malnutrition, particularly of the protein-calorie type, is prevalent among hospitalized patients. While anthropometric measurements and laboratory determinations provide objective information about nutritional status, malnutrition can be identified by a skilled physician using clinical judgment. Malnutrition should be considered in patients who have recently lost a spouse, have had recent weight loss, are institutionalized, or who have chronic lung disease, alcoholism, cancer, or residual manifestations of a stroke. Protein deficiency is an evident or potential problem in these conditions. In such cases, assessment of daily protein intake is important. Although a dietician can be very helpful in determining the precise dietary intakes of various nutrients, a reasonable estimate of protein intake can be made using simple guidelines. Knowledge of the major sources of protein and their protein content allows for a rapid, reasonable estimate of dietary protein. Table 81.2 lists approximate values of protein in these foods. With these approximations, protein intake can be readily assessed. The recommended dietary allowance for protein is 0.8 g/kg body

Table 81.1
Routine Nutritional Evaluation

Question	Explanation
1. Do you take any vitamin or mineral supplements?	This is important in addition to questioning medications, as many do not consider vitamins as medications. Megavitamin use may be revealed.
2. Have you had any recent weight loss? <i>If yes</i> , have you been following any particular diet plan?	A brief assessment of dietary methods used for weight loss is important, as some reducing diets are hazardous.
3. Have you been experiencing undue fatigue or lack of energy? <i>If yes</i> , have you recently changed eating habits? Tell me what you've eaten so far today or yesterday.	This is an extremely common and vague symptom, but occasionally can be due to poor dietary habits or nutrient imbalance.
4. Have you noted a loss of appetite or altered taste sensations?	This can be evidence for nutrient imbalance or specific deficiency such as zinc.
5. Are you a vegetarian? <i>If yes</i> , do you understand the concept of complementary amino acids, and what are your sources of vitamin B ₁₂ ?	Vegetarians are generally more nutrition conscious than nonvegetarians, but if these principles are not understood, patient education is in order.

Table 81.2
Protein Content in Major Dietary Sources of Protein

Food	Protein content
Milk, all types	8 g per cup (240 cc)
Cheese, most types	6 g per 30 g slice
Egg	8 g per egg
Beef, pork, chicken, fish	20 g per 100 g serving
Bread	2 g per 30 g slice
Peanut butter	5 g per 15 g serving

weight per day for maintenance. The requirement increases during conditions of stress and catabolism. Patients consuming less than 50 g protein per day by this estimate may not be getting adequate protein.

Eating habits and dietary patterns are influenced by many factors. Ambulatory patients who are having nutritional problems such as weight loss may be experiencing difficulties unrelated to disease. There may be a difficulty in obtaining or preparing foods, there may be a problem related to chewing or swallowing food, or there may be underlying

depression or a lack of social interaction. All these factors can reduce voluntary intake, are remediable, and should be considered in patients suspected of having nutritional problems.

The key to diagnosis and treatment of nutritional disorders is *awareness*. A physician should think about nutrition when reviewing medications, making clinical evaluations, or formulating treatment plans for patients with certain chronic diseases or recovering from major illnesses. In the process, the physician is likely to discover nutritional factors that may have a profound impact on health care. Table 81.3 lists diagnoses and clinical situations in which further nutritional evaluation may be indicated.

Basic Science

There is considerable variation in dietary habits and composition between individuals and between cultural populations. Despite this broad range of food sources, the basic required elements are found in the majority of dietary patterns. There are basic compounds required in the diet for optimal growth, proper metabolism, maintenance of tissues, and avoidance or recovery from certain disease states. These compounds include fat, protein, vitamins, minerals, trace elements, water, fiber and adequate calories.

Fat is important not only as a source of calories with 9 Kcal/g and as a carrier of fat-soluble vitamins, but also is required for the essential fatty acid (EFA) linoleic acid. Although EFA deficiency is rare, there are circumstances in which it can develop. Because the body has stores of fat containing linoleic acid, fasting for moderate lengths of time does not result in EFA deficiency. Nevertheless, patients maintained on fat-free parenteral nutrition may develop

EFA deficiency if they are either in positive caloric balance preventing mobilization of fat stores or on total parenteral nutrition for a prolonged period. To prevent EFA deficiency requires that approximately 2% of calories come from linoleic acid. The provision of 500 ml of intravenous lipid emulsion at weekly intervals is adequate for patients receiving total parenteral nutrition.

Hypercholesterolemia, particularly in conjunction with a decreased high-density lipoprotein fraction, is strongly correlated with coronary artery disease. The presence of heart disease, a family history of heart disease, or a family history of blood lipid disorder should prompt further questioning and laboratory lipid profile evaluation. Dietary measures that can reduce serum cholesterol include a reduction in total fat intake, an increase in the ratio of polyunsaturated to saturated fats in the diet, and possibly an increase in dietary fiber and chromium.

Specific *amino acids* are required for protein synthesis to maintain tissues, provide the necessary enzymes, and allow for continuous protein turnover. All the essential amino acids must be provided in the diet concurrently in order to be utilized. These include phenylalanine, valine, tryptophan, threonine, isoleucine, leucine, lysine, and methionine. A deficiency of one or more essential amino acids impairs effective protein synthesis. Certain foods contain complete, well-balanced proteins of high biological value. These are generally of animal origin and include milk, eggs, fish, chicken, pork, and beef. Foods such as legumes, rice, wheat, and corn contain some but not all of the essential amino acids and must be combined in a complementary manner or consumed with foods containing complete proteins. An unbalanced vegetarian diet may lead to protein deficiency, but a total vegetarian diet can be fully adequate if these concepts are understood and followed.

Protein deficiency can result from severe self-imposed diets, certain "fad" diets, alcoholism, cachexia associated with cancer, conditions in which eating can be difficult such as dysphagia, severe emphysema or periodontal disease, and eating disorders such as anorexia nervosa. If protein deficiency is suspected, a brief dietary history as described in the Technique section may reveal inadequate intake. Consultation with a dietician may be beneficial, as well as assessment of nutritional status by anthropometric measurements, serum transferrin or albumin, and total lymphocyte count.

With the availability and common usage of vitamin supplements, it is important to question patients as to whether or not they take *vitamins*. Although the use of most once daily multiple vitamin and mineral supplements is generally innocuous, the use of megadose supplements is increasingly common and potentially hazardous. The fat-soluble vitamins can accumulate and are more likely than water-soluble vitamins to cause problems with prolonged excessive consumption. Toxicity of active vitamin A, or retinoids, may develop with intakes over 50,000 IU daily for several months. This can result in headaches, hair loss, skin exfoliation, bone pain, irritability, anorexia, hepatomegaly, and pseudotumor cerebri. Carotene, the provitamin form of vitamin A found in dark green and yellow vegetables, is relatively harmless. Excess consumption results only in hypercarotenosis, or yellowing of the skin. Vitamin D toxicity may develop with intakes in excess of 50,000 IU daily for several months. The consequences of this include fatigue, mental status changes, constipation, and other features associated with hypercalcemia. In addition, the hypercalciuria can result in dehydration, kidney stone formation, and renal failure.

Table 81.3
Indications for Detailed Nutritional Evaluation

Clinical disorder	Potential nutritional abnormality
Prior gastric surgery	Iron deficiency, vitamin B ₁₂ deficiency
Prior ileal resection	Vitamins A, D, E, K, and B ₁₂ deficiency
Kidney stones	If oxalate composition, dietary changes can reduce recurrence
Dermatitis	Specific patterns characteristic of specific nutritional disorders—zinc deficiency, niacin deficiency
Vitiligo	An autoimmune disease that can be associated with pernicious anemia
Cheilosis	Riboflavin or ascorbic acid deficiencies, vitamin A toxicity
Glossitis	Iron, vitamin B ₁₂ , niacin, riboflavin, folic acid deficiencies
Hypertension	High sodium, low calcium, low magnesium may be related
Hypogeusia	Zinc or vitamin A deficiency
Aortic aneurysm	Copper deficiency
Malabsorption syndromes	Lactose intolerance; deficiencies of zinc and vitamins A, D, E, and K
Crohn's disease	Vitamin B ₁₂ and vitamin D deficiency
Sickle cell anemia	Zinc deficiency, folic acid deficiency
Infertility in males	Zinc deficiency
Chronic total parenteral nutrition	Zinc deficiency, copper deficiency, essential fatty acid deficiency, vitamin K deficiency

Although the water-soluble vitamins in excess are less likely to cause problems, there have been clinically significant manifestations. Excessive vitamin C, or ascorbic acid, can promote the formation of kidney stones, and large doses acutely can cause gastrointestinal disturbances. Human studies indicate that 200 mg daily results in saturation, with greater doses resulting in decreased absorption, increased excretion, and the potential for a transient deficiency state when the intake is reduced to recommended levels. Vitamin B₆, or pyridoxine, has been reported to cause an unusual neuropathy at chronic high doses. Niacin in large doses may cause gastrointestinal disturbances including liver dysfunction.

Supplementation with *minerals and trace elements* can result in a significant imbalance of nutrients. Excessive quantities of one substance can antagonize another essential nutrient. Chronic excessive zinc intake can produce copper deficiency, and high manganese intake impairs absorption of iron. These are examples of known potentially detrimental effects from high intakes of specific minerals. It is likely that isolated increased intake of other minerals and trace elements could have adverse effects. The key here is

moderation, and the use of pharmacologic doses of minerals in the absence of demonstrated deficiency should be discouraged.

Clinical Significance

Nutrition plays a major role in health, prevention of disease, and recovery from illness. While the role of nutrition is obvious in certain medical problems, it is subtle in many others. Knowledge of potential interactions with nutrition can be extremely valuable clinically. Such interactions can be categorized to facilitate logical evaluation. After a careful history, physical examination, and preliminary laboratory studies are performed, consideration of the impact of diet on these findings is often clinically rewarding. Categories of nutrient interactions are listed in Tables 81.4 through 81.6 in a manner that can be quickly scanned to detect relevant clinical ramifications.

As the general population increases its interest in nutrition, it is crucial for physicians similarly to intensify their awareness and knowledge of nutrition. Consideration of the

Table 81.4
Drug–Nutrient Interactions

Drug	Nutritional manifestation
Cycloserine	Increased requirement for vitamin B ₆ (pyridoxine), to prevent neuropathy
L-dopa	Increased requirement for vitamin B ₆ , to prevent neuropathy
Isoniazid	Increased requirement for vitamin B ₆ , to prevent neuropathy
Penicillamine	Increased requirement for vitamin B ₆ , to prevent neuropathy; hyperzincuria and zinc deficiency
Diphenylhydantoin	Increased requirement for vitamin D
Phenobarbital	Increased requirement for vitamin D
Isoniazid	Increased requirement for vitamin D
Cimetidine	Increased requirement for vitamin D
Aluminum hydroxide antacids	Phosphate depletion, osteomalacia
Colchicine	Decreased absorption of fat, nitrogen, lactose, sodium, potassium, calcium, iron, vitamin B ₁₂
Thiazides	Increased excretion of potassium, magnesium, zinc
Furosemide	Increased excretion of potassium, magnesium, zinc
Methotrexate	Folic acid antagonism; impaired absorption of calcium
Cis-platinum	Increased excretion of zinc and magnesium
Digitalis	Increased excretion of zinc and magnesium
Ethanol	Increased excretion of zinc, magnesium and potassium; impaired absorption and metabolism of folic acid and thiamine
Antacids	Decreased absorption of folic acid by increasing pH
Cholestyramine	Impaired absorption of vitamins A, D, E, and K, and folic acid
Colestipol	Impaired absorption of vitamins A, D, E, and K, and folic acid
Nitrous oxide anesthesia	Impaired utilization of vitamin B ₁₂
Oral contraceptives	Increased requirement for folic acid and vitamin B ₆

Table 81.5
Nutrient–Drug Interactions

Nutrient	Effect on drug
Calcium	Interferes with simultaneous tetracycline absorption
Magnesium	Interferes with simultaneous tetracycline absorption
Iron	Interferes with simultaneous tetracycline absorption
Pyridoxine	Increases metabolism of L-dopa
High-protein diet	Increases hepatic metabolism of drugs
Low-protein, high-carbohydrate diet	Reduces hepatic metabolism of drugs
Vegetables of <i>Brassica</i> group (cauliflower, Brussels sprouts, cabbage, broccoli)	Increase hepatic metabolism of drugs

Table 81.6
Nutrient–Nutrient Interactions

Nutrient	Nutrient interaction
Vitamin C	Given with iron enhances absorption
Calcium	Important for absorption of vitamin B ₁₂
Vitamin A	Deficiency impairs iron transport
Copper	Deficiency impairs iron metabolism
Chromium	Deficiency can cause glucose intolerance and elevated serum cholesterol
Polyunsaturated fatty acids	Causes proportional increase in vitamin E requirement
Protein intake	Causes proportional increase in vitamin B ₆ requirement
Carbohydrate intake	Causes proportional increase in thiamine requirement
Manganese	Excess antagonizes iron absorption
Zinc	Excess can cause copper deficiency
Fiber	Specific types can impair absorption of minerals or cholesterol; can improve glucose intolerance

role of nutrition in clinical conditions and patient care is the essential first step. This can be followed by selected nutritional history or evaluation and consultation with a clinical dietician. These measures can greatly enhance the health maintenance and therapeutic interventions in patient care.

References

- Alhadeff L, Gualtieri CT, Lipton M. Toxic effects of water-soluble vitamins. *Nutr Rev* 1984;42:33–40.
- Baker JP, Detsky AS, Wesson DE, Wolman SL, Stewart S, Whitewell J, Langer B, Jeejeebhoy KN. Nutritional assessment: a comparison of clinical judgment and objective measurements. *N Engl J Med* 1982;306:969–72.
- Blackburn GL, Bistrian BR, Maini BS, et al. Nutritional and metabolic assessment of the hospitalized patient. *JPEN* 1977;1:11–12.
- *Goodhart RS, Shils ME, eds. *Modern nutrition in health and disease*, 6th ed. Philadelphia: Lea and Febiger, 1980.
- Goodman JT, Lowry SF, Brennan MF. Essential fatty acid deficiency in total parenteral nutrition: time course of development and suggestions for therapy. *Surgery* 1978;84:271–77.
- Hahn TJ, Mendin BA, Scharp CR, et al. Effect of chronic anti-convulsant therapy on serum 25-hydroxycalciferol levels in adults. *N Engl J Med* 1972;287:900–904.
- Lappe, FM. *Diet for a small planet*. New York: Random House, 1976.
- McCurdy PR, Dern RJ. Some therapeutic implications of ferrous sulfate-ascorbic acid mixtures. *Am J Clin Nutr* 1968;21:284–88.
- National Research Council, Food and Nutrition Board, Recommended dietary allowances, 9th ed. Washington, D.C. National Academy of Sciences, 1980.
- Patterson WP, Winkelmann M, Perry MC. Zinc-induced copper deficiency: megamineral sideroblastic anemia. *Ann Intern Med* 1985;103:385–86.
- Roe, DA. Nutrient and drug interactions. *Nutr Rev* 1984;42:141–54.
- Schaumburg H, Kaplan J, Windebank A, et al. Sensory neuropathy from pyridoxine abuse. *N Engl J Med* 1983;309:445–48.
- Schilling RF. Is nitrous oxide a dangerous anesthetic for vitamin B₁₂-deficient subjects? *JAMA* 1986;255:1605–6.